TECHNICAL PUBLICATION

TEST AND EVALUATION REPORT

3M CASUAL COMPACT COPIER

NPIC/R-14/69

FEBRUARY 1969

GROUP 1 EXCLUDED FROM AUTOMATIC DOWNGRADING AND DECLASSIFICATION

CONFIDENTIAL

WARNING

This document contains information affecting the national defense of the United States, within the meaning of Title 18, sections 793 and 794, of the U.S. Code, as amended. Its transmission or revelation of its contents to or receipt by an unauthorized person is prohibited by law.

Approved For Release 2000/05/10 : CIA-RDP78B04560A006800010011-2

TECHNICAL PUBLICATION

TEST AND EVALUATION REPORT

3M CASUAL COMPACT COPIER

FEBRUARY 1969

T & E Report No. 69-01

25X1A [redacted]

Test and Evaluation Branch
Engineering Support Division
Technical Services and Support Group
NATIONAL PHOTOGRAPHIC INTERPRETATION CENTER

CONFIDENTIAL

CONTENTS

FIGURES

ABSTRACT

The 3M Casual Compact Copier, a portable document copier built into a small plastic case, duplicates documents by a dry process which uses specially treated transfer and copy paper. It is well designed and fabricated, considering its low cost, and meets requirements for infrequent copying and portability. With special transparency materials the copier can produce transparent copies (viewgraphs) at a one-to-one ratio. Caution must be used in handling copy materials which fog relatively easily from roomlight exposure. A readable image remains for a time on the intermediate transfer paper and could cause a breach of security if classified documents are copied and the transfer sheet is improperly discarded.

This report describes in detail the copier and copy materials, tests, and test results. Photographs of the equipment and copy samples are included.

Test and Evaluation
of
3M Casual Compact Copier

1. INTRODUCTION

1.1. Objective

1.1.1. The objective of this project was to test and evaluate 3M Casual Compact Copier to determine its physical characteristics, its functional and overall operating capabilities, and the quality of the copy it produces.

1.2. Background Information

1.2.1. The 3M Casual Compact Copier (Figures 1-4) is manufactured by the Duplicating Products Division, Minnesota Mining and Manufacturing (3M) Company, St. Paul, Minnesota. A portable document copier built into a small carrying case, it duplicates by a dry process without the use of chemicals. Cost per unit is $69.95.

1.2.2. Copy paper comes in two attached packages, one containing sheets of pink intermediate transfer paper and the other containing white paper for the final copy. Letter-size paper ($8\frac{1}{2}$ by 11 inches) is available at $4.50 for 50 sets (50 transfer sheets, 50 final sheets) and $8.15 for 100 sets. Legal-size paper ($8\frac{1}{2}$ by 14 inches) is $5.95 for 50 sets and $10.40 for 100 sets. Cost of material is approximately ten cents per copy.

1.2.3. Additional tests were conducted using 3M Projection Transparency Material Type 628, which produces black lines on a clear background but is exposed and processed like the white copy paper. Type 628 ($8\frac{1}{2}$ by $10\frac{1}{2}$ inches) comes in two attached packages, one containing pink intermediate transfer paper and the other containing the transparency stock for the final copy. Cost is $35.40 for 100 sets.

1.2.4. Manufacturer's sales literature states that the copier is not intended to replace large office copiers but is designed for businesses with light or infrequent copying needs and for business trips.

1.2.5. The copier was purchased as off-the-shelf equipment (not on contract) for possible utilization. No established requirements have been given for the equipment.

2. SUMMARY OF TEST RESULTS

2.1. The carrying case, an integral part of the copier, is sufficiently durable for normal hand transporting; but its strength may not survive rough handling. (See section 5.1.)

2.2. The exposure unit, which contains a reflector partially constructed from cardboard, is not likely to endure extended use. The unit may warp or bonded surfaces may separate if the unit is stored in the closed carrying case while the processor is hot. (5.1.)

2.3. Electrical design and fabrication are satisfactory for safety and proper function. (5.2.)

2.4 All operational components are sufficiently controlled to give copies of repeatable quality. Exposure may vary slightly because of local wall outlet voltage variations and/or age of the exposing photoflood bulb which changes light intensity. (5.3.)

2.5 No physical damage to original documents or change in copy quality occurs with extended use of the copier. Temperature rise at the platen has no adverse effect. (5.4.)

2.6. The light intensity fall-off from center to edge of the printing plane is approximately 20 percent, which is not objectionable when making letter-size copies. Copies longer than $13\frac{1}{4}$ inches cannot be satisfactorily exposed because of the size of the exposure unit's reflector. This prevents making copies over the entire 14-inch length of legal-size copy paper. (5.5.)

2.7. Copy materials, when left open to office roomlight for only a minute and a half fog sufficiently to deteriorate the quality of copies. (5.6.)

2.8. Readable images remain on pink intermediate sheets after being peeled from the copy. Although roomlight gradually erases this image, a sheet covered from light shortly after making a copy was legible three days later. (5.7.)

2.9. Projection Transparency Material Type 628 can be exposed and processed in the copier to produce good quality positive line and halftone copies (viewgraphs) for overhead projection. Copies were a dark brown tone, perhaps because old materials on hand were used for conducting the test.

3. CONCLUSIONS

3.1. The 3M Casual Compact Copier is well designed and fabricated considering its low cost. It will meet requirements for infrequent copying and portability, the intent of the manufacturer's design concept.

3.2. The copier repeatedly makes high quality letter-size ($8\frac{1}{2}$ by 11-inch) copies at a materials cost of approximately ten cents each, but it cannot print the full 14-inch length of legal-size copies.

3.3. It cannot be expected to hold up if used frequently or if transported with rough handling. The unit's low cost, however, makes replacement practical.

3.4. Copy materials must be handled cautiously in bright roomlight to achieve the highest quality copies. Materials can fog relatively easily from roomlight exposure.

3.5. A breach of security could occur when making classified document copies if the pink intermediate sheet is discarded improperly.

3.6. The copier can be used for making occasional overhead projection transparencies of line and halftone originals.

4. DESCRIPTION

4.1. General

4.1.1. The 3M Casual Compact Copier is a portable document copier built into a small carrying case. Documents are copied by a dry process without chemicals. A pink translucent intermediate transfer sheet is placed on the original document, exposed to light, placed in contact with white copy paper, and thermally developed. After development the transfer sheet is peeled away and discarded. It is good for only one copy.

4.1.2. The copier uses the 3M Dual Spectrum Process, which produces black on white positive copies. The intermediate transfer sheet contains a developing agent which is reduced proportionally with different levels of light exposure. Light transmitted through the sheet is reflected from the document being copied and reduces the developing agent. The intermediate transfer sheet is then placed in contact with the emulsion-coated copy paper. The sheets are thermally processed together to transfer the remaining developing agent to the copy paper and produce the duplicate.

4.1.3. Copies can be made from typed, written, drawn, or printed originals. Black and white copies with middle tone rendition can be made from halftones and color background originals. Pages from bound books and magazines can be duplicated without harm to the original.

4.2. Carrying Case

4.2.1. The copier is built into its own hard plastic attache-styled carrying case. Its small size and light weight give the portability needed for carrying on business trips. It is small enough to store under seats in commercial aircraft, but does not appear durable enough to stand the rough treatment which checked baggage can receive.

4.3. Exposure Unit

4.3.1. The exposure unit consists of a No 1 photoflood light source mounted on a cardboard reflector. The reflector, which spreads open for use and folds for storage, is plastic covered on the outside and has a reflecting surface on the inside. The handle mounted on the plastic top of the unit projects through the top of the carrying case when closed to serve as the carrying case handle. A power cable for the light source and a pushbutton light switch are provided. The button must be held down for making exposures.

4.4. Developer Unit

4.4.1. The developer unit is the base of the carrying case. Both sides

of the case hinge on this unit. It contains a soft mohair-covered roller 9½ inches wide and 1½ inches in diameter. This transports material for developing past a controlled temperature heat shoe of approximately 250 degrees F. Roller speed is fixed at six revolutions per minute, which transports a letter-size copy through the developer in approximately 33 seconds. Also in the unit is a timer marked in second increments for observing time of exposure. An outlet is provided on the developer unit for supplying power to the exposure unit.

4.5. Functional and Physical Characteristics

4.5.1. Weight 11 3/4 pounds

4.5.2. Dimensions (inches)

	Width	Depth	Height
Copier, Case Closed (Figure 1)	16	5½	13 3/4
Copier, Case Open (Figure 2)			
Case Only	30½	16	3
Exposure Unit on Copy Glass	30½	16	12

4.5.3. Approximate Area Required for Equipment and Operator

Width: 3 feet
Depth: 4 feet

4.5.4. Power Requirements

115 volts, 60 hertz (single phase)
6½ amps (exposing lamp--2 amps; processor transport motor and heater--4½ amps)

4.5.5. Originals -- The copier can duplicate typed, written, drawn, or printed originals. It makes black and white copies with midtone rendition from halftones and originals with colored backgrounds.

4.5.6. Copy Materials -- Fifty sets of letter-size copy paper are supplied with the copier. Additional paper is available as described in paragraph 1.2.2. 3M Projection Transparency Material Type 628 can also be used with the copier (1.2.3.).

5. TEST DETAILS

5.1. Physical Examination

5.1.1. The purpose of this test was to examine the functional design and fabrication quality of the copier.

5.1.2. The carrying case is lightweight plastic and durable enough for normal hand transporting. It is questionable, however, that the case will withstand the rough handling associated with checked baggage on commercial carriers. Although latches on the case look as though they will fail due to material fatigue, the latch manufacturer (Southco) states that they are made from polypropylene, a material which has the capacity for unlimited flexing. Latches of this type (molded in one piece with integrally hinged sections) have been tested successfully through one million continuous openings and closings by the manufacturer.

5.1.3. The exposure unit, which has a plastic covered cardboard reflector, is likely to tear apart with extended use. Excessive heat generated by the light source and/or the developer unit will speed this process, so the case should not be folded for storage until the developer unit has cooled.

5.2. Electrical Examination

5.2.1. All electrical components of the copier were examined for proper function and safety.

5.2.2. Power consumption was measured using a model RS-300 Amprobe. Power requirements are listed in section 4.5.4.

5.2.3. The copier is not grounded and does not have a fused circuit or an "off-on" switch. These items, however, are not necessary for the safe operation of the unit because of its plastic construction and its simple electrical requirements.

5.3. Functional Test

5.3.1. The purpose of this test was to determine the operational characteristics of those basic components of the copier which may affect the operator's ability to consistently produce repeatable results.

5.3.2. The exposure light intensity, time indicator, developer temperature, and roller transport speed were checked to determine their normal range and accuracy of control.

5.3.3. As the manufacturer has stated in instructions, exposures can vary as much as ten seconds due to the difference in wall outlet voltage. A

test was conducted, making copies with 110- and 120-volt inputs to the copier. This variation, which could be considered normal for many locations, does not affect the time indicator, developer temperature, and roller transport speed. The exposure light intensity, however, does vary with changing voltage. Copies exposed at 110 volts for 35 seconds approximately equalled the density of those exposed at 120 volts for 25 seconds.

5.3.4. The developer temperature is thermostatically controlled between 245 and 250 degrees F, with a variation of approximately three degrees from roller center to ends. The unit heats from ambient temperature to this controlled temperature range in approximately one minute.

5.4. Printing Plane Temperature Test

5.4.1. The purpose of this test was to establish the temperature rise at the printing platen after operating the copier for a period of time. Elevated temperature at the platen could possibly damage originals or develop copy materials prematurely, thereby making it difficult to maintain copy quality.

5.4.2. For this test the reproduction of ten consecutive copies from a single original was simulated. Thirty-second exposures were made allowing time between exposures for inserting new copy materials. A remote sensor thermocouple probe was placed under the copy glass in the copy material's normal position. The platen was closed and temperature readings were taken at the end of each exposure.

5.4.3. After the first exposure the temperature at the platen had risen to 110 degrees; after the tenth exposure the temperature was 158 degrees. Exposures made at these two temperatures produced apparently identical copies. The original document was not damaged.

5.5. Printing Plane Illumination Uniformity Test

5.5.1. This test was conducted to determine the uniformity of illumination at the printing plane.

5.5.2. To position the sensor the exposure unit was turned upside down and the frosted glass which normally covers the original and transfer sheet during exposure was placed so that the reflector-glass relationship was the same as when making a copy exposure. Light intensity readings were made in the center and along the edges of the lighted surface using a Gossen Foot-Candle Meter with a $1\frac{1}{2}$-inch diameter probe.

5.5.3. The light intensity fall-off from center to edge of the glass was approximately 20 percent. Illumination level at the center of the glass was 12,000 foot-candles with a 115-volt input.

5.5.4. Illumination fall-off is not objectionable when making a letter-size copy ($8\frac{1}{2}$ by 11 inches). Legal-size paper was not available for testing, so two sheets of letter-size pink intermediate paper were overlapped on a legal-size original and an exposure was made. After processing, the copies were placed together to match the original document, and the usable copy area was measured. The maximum paper length which can be exposed properly is $13\frac{1}{4}$ inches. This precludes making single sheet legal-size copies ($8\frac{1}{2}$ by 14 inches). The exposure unit's 8 3/4- by $13\frac{1}{2}$-inch opening is the major reason for this restriction.

5.6. Fog Test

5.6.1. The purpose of this test was to determine how long copy materials can be left open to roomlight under normal working conditions without fogging and thus deteriorating the quality of copies made.

5.6.2. Instructions supplied by the manufacturer state that copy materials should be removed from their packages one sheet at a time and the package closed immediately to protect the sheets from light.

5.6.3. Pink intermediate and white copy paper were exposed for various lengths of time to an overhead fluorescent office light of 110-foot-candle intensity prior to use.

5.6.4. A pink intermediate sheet exposed to roomlight for one and a half minutes produced a copy with slightly lighter letters. A three-minute exposure made the copy letters much lighter and objectionable. Five minutes of roomlight exposure to the white sheet made an objectionable change to the copy by building up an overall background density.

5.7. Residual Image Examination

5.7.1. This examination was made to determine if any residual image is left on the pink intermediate transfer sheet after processing. Manufacturer's instructions received with the copier state that after development the pink sheet should be peeled away and discarded. If the image of a classified document remains on the sheet, a breach of security results in discarding the pink sheet improperly.

5.7.2. Several pink intermediate sheets peeled away from copies of typed documents were closely examined. In every case a weak but readable image was present on the pink sheet after it was peeled from the copy. When the sheet was left exposed to a normal office roomlight (110-foot-candle intensity) the visual image disappeared in less than twenty minutes. Another pink sheet was covered from light shortly after making a copy and examined three days later. Print was still legible. This sheet was then exposed to office roomlight for twenty minutes and, as in the first case, the

visible image disappeared.

5.8. Copy Fidelity

5.8.1. Several types of copies were made to determine the versatility of the copier and the fidelity of its copies.

5.8.2. To make copies of the highest fidelity good contact between the original and the intermediate paper is necessary. Otherwise fuzzy light areas will appear on the finished copy. Good contact is not difficult with a single original, but two documents with a distinct difference in thickness cannot be copied at the same time without obtaining some fuzzy areas.

5.8.3. Good quality copies were made from sections of large originals and pages of bound books using the instructions included with the copier.

5.8.4. Colored maps and both black and white and colored lithographic reproductions were copied with varying degrees of success, depending on the rendition of specific colors.

5.8.5. Copy samples are attached to the report (Figures 5 and 6).

5.9. Projection Transparency Copy Test

5.9.1. The purpose of this test was to determine if 3M Projection Transparency Material Type 628 could be exposed and processed properly with the Casual Compact Copier. This material is suited for making viewgraphs for overhead projection.

5.9.2. Type 628 pink intermediate sheets were exposed and then thermally processed with the transparent copy material. Exposure and development times were changed between samples to obtain satisfying reproductions. Since transport speed of the processor is fixed, time of development was changed by running the material through the developer unit two or three times to obtain complete development of the image.

5.9.3. Good quality transparent copies suitable for overhead projection were obtained from line and halftone originals. This was accomplished by one-minute exposures and three cycles through the developer unit. Lines of a four-color map and halftones of other originals were reproduced as brown tones instead of neutral tones. This could be a normal characteristic of the material or the result of using old materials. New materials were not on hand for this test.

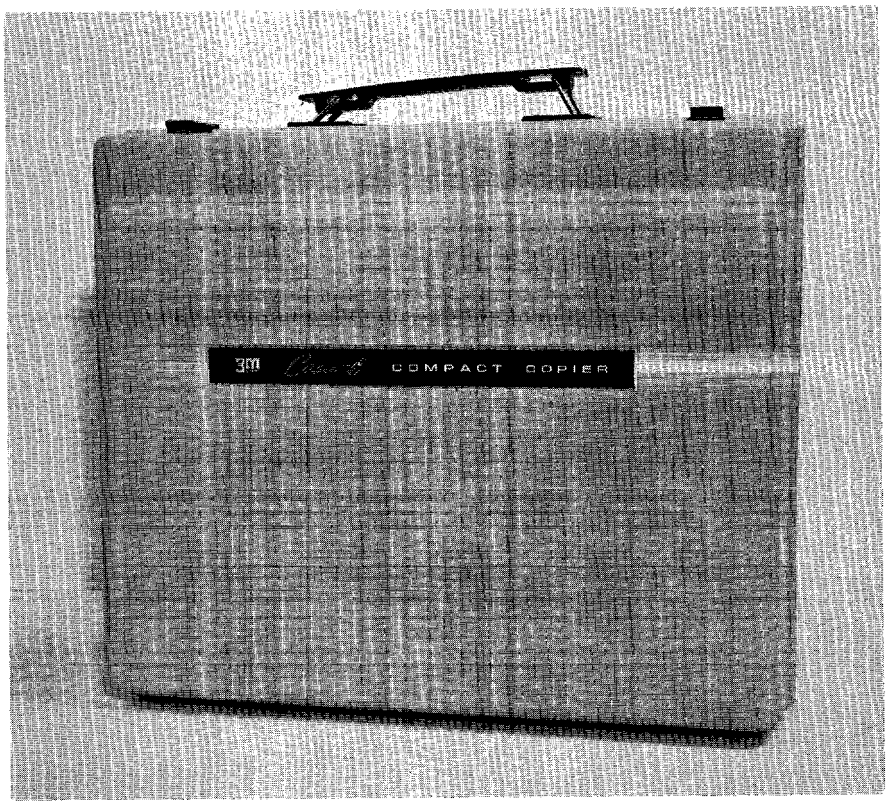

FIGURE 1. 3M CASUAL COMPACT COPIER.

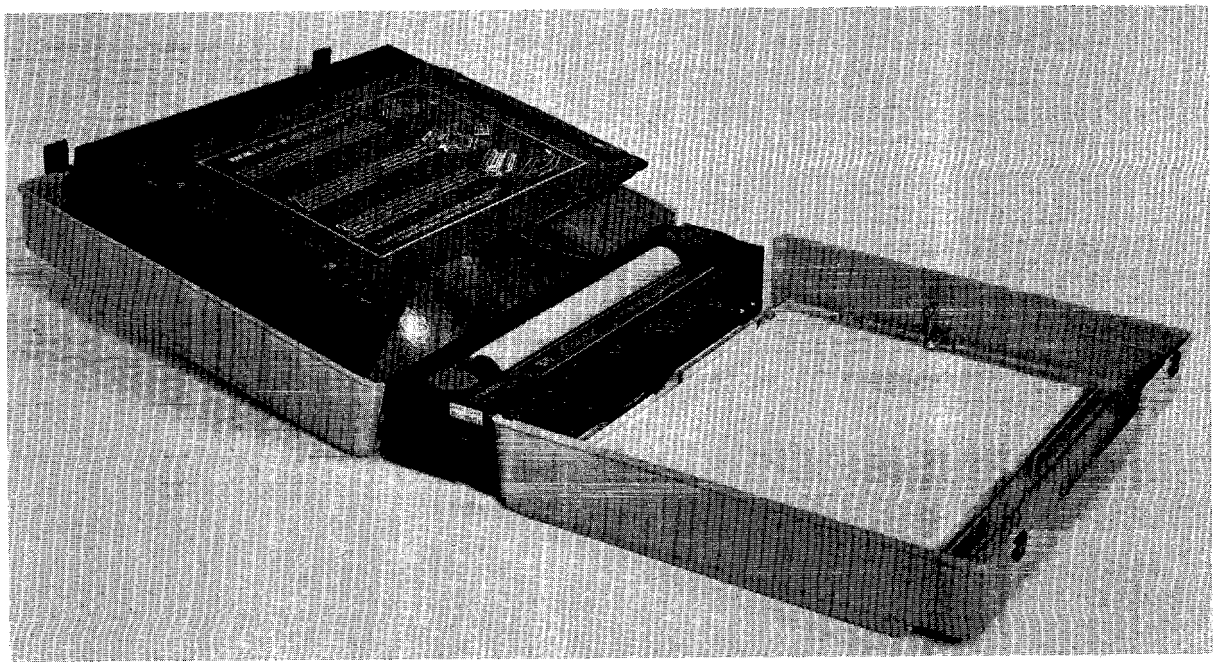

FIGURE 2. COPIER WITH EXPOSURE UNIT FOLDED INTO POSITION FOR CLOSING CASE.

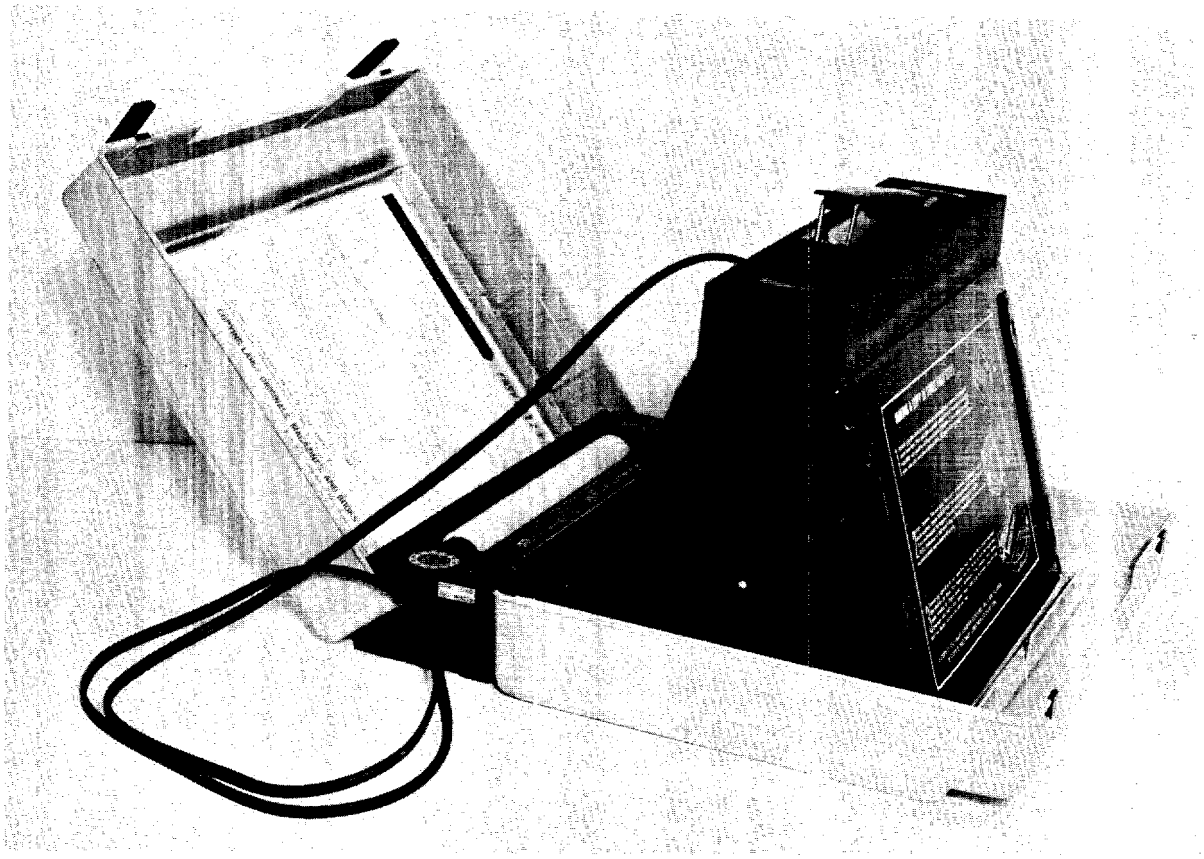

FIGURE 3. COPIER, SHOWING MODE OF OPERATION FOR MAKING COPY EXPOSURE.

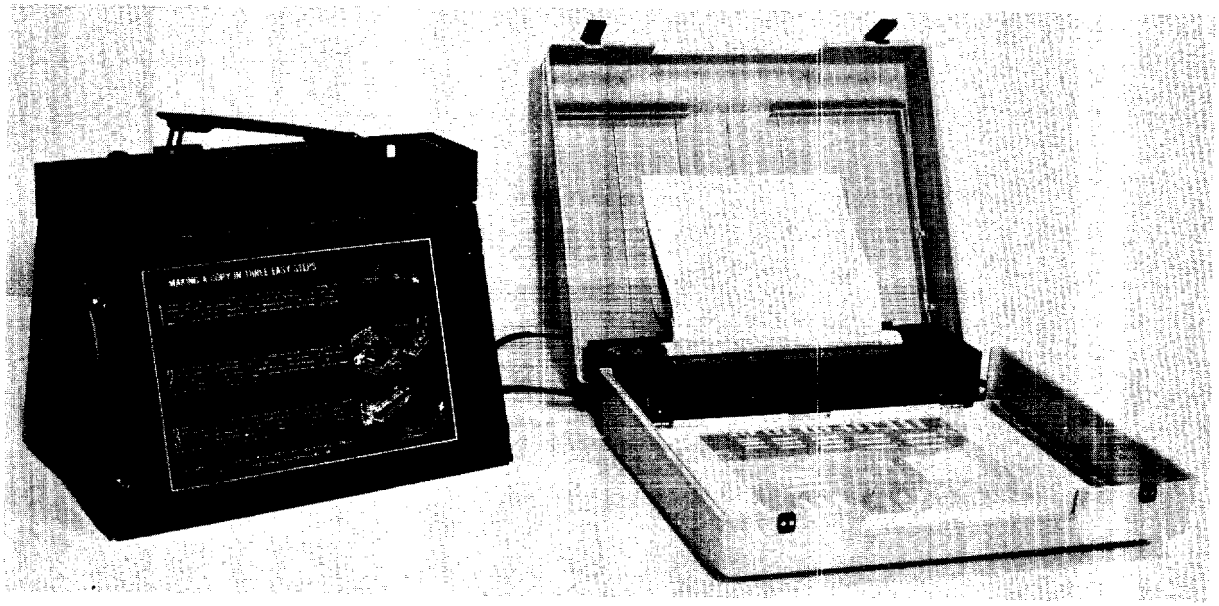

FIGURE 4. COPY PAPER AND PINK TRANSFER SHEET BEING PROCESSED IN HEAT DEVELOPER.

COPY SAMPLE

This is a letter size copy made with the 3M Casual Compact Copier. The purpose of this sample is to give the reader an example of the copy quality obtainable with this copier. This portion of the original document was typed with an electric typewriter. The original document was prepared on government white bond paper.

This portion of the document was typed on both sides of the paper using an electric typewriter. The lines are so spaced that the typed lines on the backside of the original document were positioned in the space area of the typed lines on the front side.

These words were typed on the original using carbon paper.

These words were written on the original using a ballpoint pen.

These words were written on the original using a number 2-4 grade pencil.

Asterisks typed around the edges and in the center of the original show the outer limits of 8 by 10½ inch letter size paper. They can be used to compare the evenness of copy over the extreme edges of this size paper. Legal size copy paper was not available for testing the copier.

FIGURE 5. COPY SAMPLE. Letter-size copy of an original in type, ballpoint pen, and pencil.

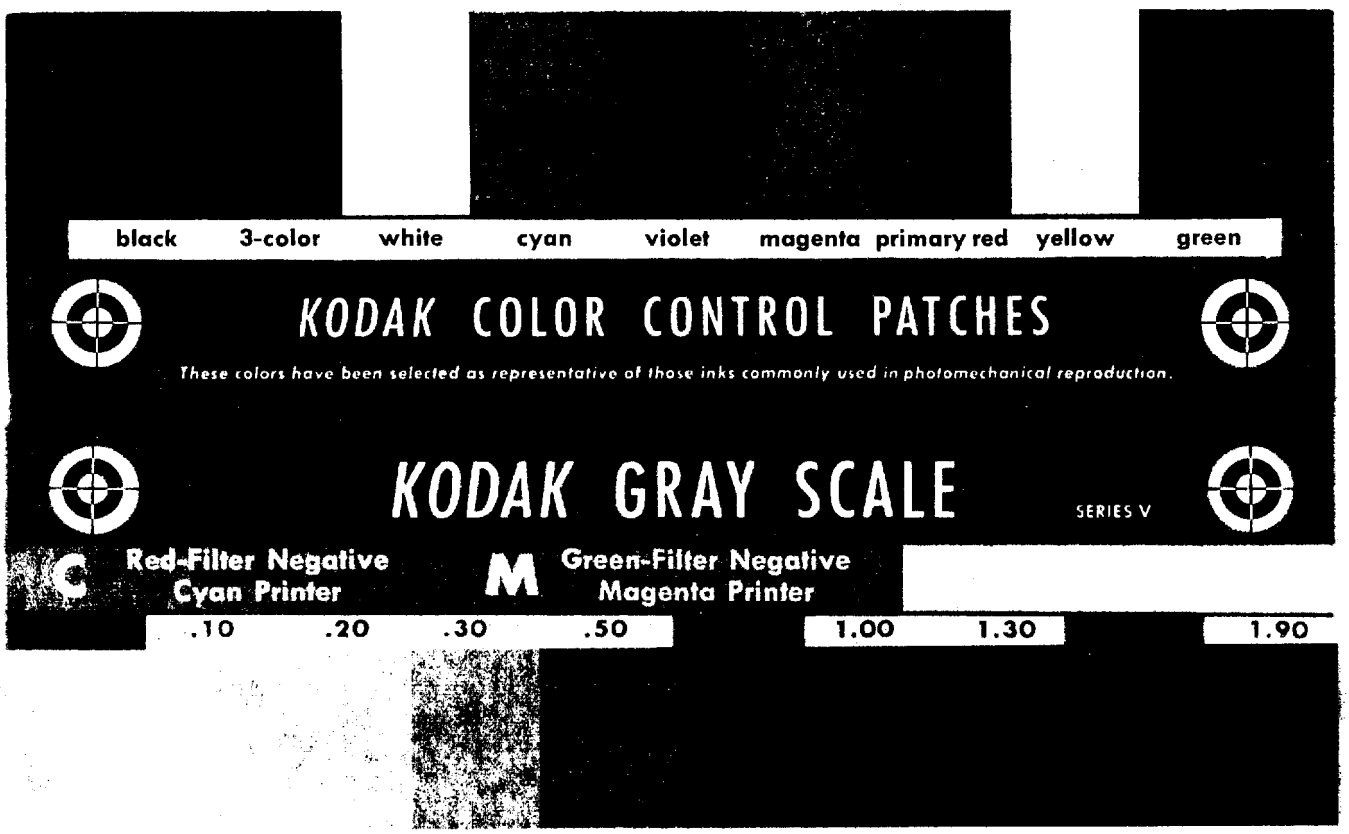

FIGURE 6. COPY SAMPLE. Copy of Kodak Color Control Patches and Kodak Gray Scale showing spectral response and midtone rendition.